Table 2. Height distributions compared with distribution predicted from mean and S.D. of height units calculated in Table 1. Numbers in parentheses indicate number of subjects.

Subjects	Height bracket by ½ standard deviations												Goodness of fit χ^2 (7 d.f.)
	< −2.50	−2.50 to −2.01	−2.00 to −1.51	−1.50 to −1.01	−1.00 to −0.51	−0.50 to −0.01	0.00 to 0.49	0.50 to 0.99	1.00 to 1.49	1.50 to 1.99	2.00 to 2.49	≥2.50	
						Institution A							
White (86)													
Observed	0	3	2	5	16	14	19	17	7	1	1	1	7.5
Expected	2.0		3.8	7.9	12.8	16.5	16.5	12.8	7.9	3.8	2.0		$P \sim .35$
Black (117)													
Observed	0	2	6	12	17	16	29	17	10	6	1	1	4.6
Expected	2.6		5.2	10.8	17.4	22.5	22.2	17.4	10.8	2.5	2.6		$P \sim .7$
						Institution B							
White (44)													
Observed	1	0	3	4	4	8	8	11	2	2	1	0	5.7
Expected	1.0		1.9	4.0	6.6	8.4	8.4	6.6	4.0	1.9	1.0		$P \sim .55$
Black (44)													
Observed	0	1	3	1	9	9	7	6	6	2	0	0	6.1
Expected	1.0		1.9	4.0	6.6	8.4	8.4	6.6	4.0	1.9	1.0		$P \sim .50$

is the appropriate height for his age, a child "− 1.5" units is one and a half standard deviations below the mean appropriate height for his age, and so forth. The distributions of these data for the XY boys were compared with the normal distribution of the standards (Table 1). The means of these calculated units and their standard deviations from the means were determined and are also noted. The observed distributions were then compared with that predicted by normal distributions with the same means and variances (Table 2).

The two groups of black children and the white children in Institution B have height distributions that are not significantly different from those predicted by the published standards, and the mean heights are not significantly different from 0 units. (It is possible that the standards for the black children would have been higher if data from upper-middle-class black families were available.) The distribution is markedly different for the white children in institution A. Children here are on the average −0.65 height units and are significantly smaller than the standards.

However, there was not a significant enrichment of tall boys judged either by the published standards (Table 1) or by the calculated distributions of the populations themselves (Table 2). For instance, in the total of the four groups there are 15 boys greater than 1.5 height units in custody (Table 1) and 16 boys with heights greater than 1.5 standard deviations for the mean of their group (Table 2). But the expected number of such individuals is 19.6 in both cases. For 2 height units or 2 standard deviations the corresponding figures are 6 and 5 observed, compared to 6.4 expected.

If large height were the sole explanation for the higher incidence of the XYY genotype among delinquents, then one would expect the height of XYY children to have the same distribution as that of delinquent XY boys in these institutions.

In the four groups there were three XYY children all in Institution A. Their socioeconomic backgrounds were similar to those of the other boys. Their IQ's ranged from 1 to 15 points lower than the average of boys of the same race and age in their institution. One white XYY child was 0.52 height units and in the upper 90 percent of his group for size, and two black children were 2.13 and 2.91 height units and in the upper 97 percent and 99 percent of their group for size, respectively. The probability of finding randomly three children with these or taller relative heights is extremely small ($P < .001$).

We interpret the data as indicating that large height per se during late childhood is not exclusively responsible for the frequency of delinquency among XYY individuals and is unlikely to be a strong contributory cause.

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3. Note added in proof: While this report was in press we became aware that S. Glueck and E. Glueck found no significant difference in height between delinquent and nondelinquent boys between 11 and 18 years of age [*Unraveling Juvenile Delinquency* (Commonwealth Fund, New York, 1950), pp. 184–85].

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Unilateral Ablation of the Auditory Cortex in the Cat Impairs Complex Sound Localization

Abstract. *Unilateral ablation of the auditory cortex in the cat results in a profound deficit in attending to stimuli on the side contralateral to the lesion. The deficit is also manifested in an abnormal perception of left-right pulse pairs when the pulse which leads by a few milliseconds is contralateral to the damaged hemisphere.*

We planned these experiments to test the idea that an important function of the auditory cortex may be the identification of a particular locus when identical sounds emanate from different loci at closely spaced temporal intervals (*1, 2*). In the course of this inquiry a profound deficit in auditory discrimination was uncovered after the unilateral ablation of the auditory cortex, and, since deficits are not commonly found after such ablations, we believe that a preliminary report may be worthwhile.

Eight cats were first trained in a Y maze to approach the food box on the side of a sound source (*1*). The stimulus indicating that the correct side was either left (L) or right (R) was a train of 1-khz tone pulses of 23-msec duration, presented five per second. The train of tone pulses was turned on 10 seconds before the animal was released from the start box and was left on until the animal reached the goal door. The intensity of the tone pulses was 50 db sound pressure level in the start box. When the cats had mastered the simple localization of single sources, the task was complicated by the introduction of trials in which sound was delivered by both speakers. Such trials alternated in a random way with trials in which only the left speaker sounded, with the provision that six trials of each type were given during every training session. Figure 1A depicts the cat's task in a schematic way: when only the left speaker sounded, the cat had to choose the left side; when both speakers delivered tone pulses, the cat had to choose the right side. For the sake of convenience, this task, in both the text and tables, is represented by the phrase L versus L + R. When both speakers delivered tone pulses, either the left speaker led the right by 30 msec or the two speakers, while still having nominally the same pulse repetition rate, were unsynchronized. To normal cats these two conditions were equivalent, and for the present purpose it is not necessary to differentiate between them. What is more significant is the test we developed by reducing the interpulse interval to 5 msec using the method of synchronizing the members of a pulse pair. In contrast to the previous task, the closely spaced pulse pair will be symbolized by LR or RL, depending on which came first. Such test trials were interspersed among regular trials in test sessions after the cat's attainment of criterion performance, namely, one errorless training session. From these tests it was established that every normal cat responded to an LR pulse pair (L leading R by 5 msec) as a single sound on the left. An attempt was then made to ablate all auditory cortex of one hemisphere from the middle suprasylvian sulcus to the rhinal fissure. The cortex was removed by subpial aspiration with strict aseptic precautions. In four cats the cortex of the left hemisphere was removed, and in the other four the cortex of the right hemisphere was removed. After a 14-day recovery period, each of the eight cats was returned to the training apparatus and was presented with the task of discriminating L from L + R.

Table 1. Average number of sessions before the attainment of the criterion.

Task	Left lesion	Right lesion
Retraining on original task: L versus L + R	> 60	6
Reciprocal training: R versus R + L	6	> 60

The results are presented in the first line of Table 1: the four cats with lesions on the right side essentially retained the habit inasmuch as the criterion level of performance was achieved in only six sessions, on the average. Individual differences were minimal, the range being from three to seven sessions. In contrast, the four cats with lesions on the left side lost the habit, and three out of four failed to reach criterion within the limits set for retraining, namely, 60 sessions. The performances of all four cats with lesions on the left side were strikingly similar: for the greater part of the retraining period they vacillated between a chance level of 50 and 75 percent with an average of about 60 percent. This deficit stood in marked contrast to their normal capacity to distinguish single sounds on the left or right (*3*). The conclusion seems justified that the cat's response after surgery depended on the side on which the lesion was located.

A clue to the existence of a second factor determining the cat's choice of left or right sides was provided by the tests with the reduced interpulse interval. An LR pulse pair with a 5-msec interval between pulses is a "virtual left" to normal cats, and presumably an RL pulse pair is a "virtual right." The results of these tests after surgery are shown in the left half of Table 2. The cats with lesions on the left side still regarded an LR pulse pair as on the left, and, as expected, their response to an RL pulse pair was the same as their response to a single sound on the right. But the cats with lesions of the right hemisphere selected the right side not only on RL tests but also, surprisingly, on an overwhelming majority (84 percent) of LR tests. Why? A reasonable answer is that, as a result of previous training, the cats have developed a strong tendency to favor or select the right side; that is to say, since the cats are trained to select the stimulus on the right side in the face of a competing pulse from the opposite side, they will choose right in an otherwise ambiguous perceptual situation. It should be emphasized that the "favored side" is not to be mistaken for a simple position preference since none of the cats failed to respond cor-

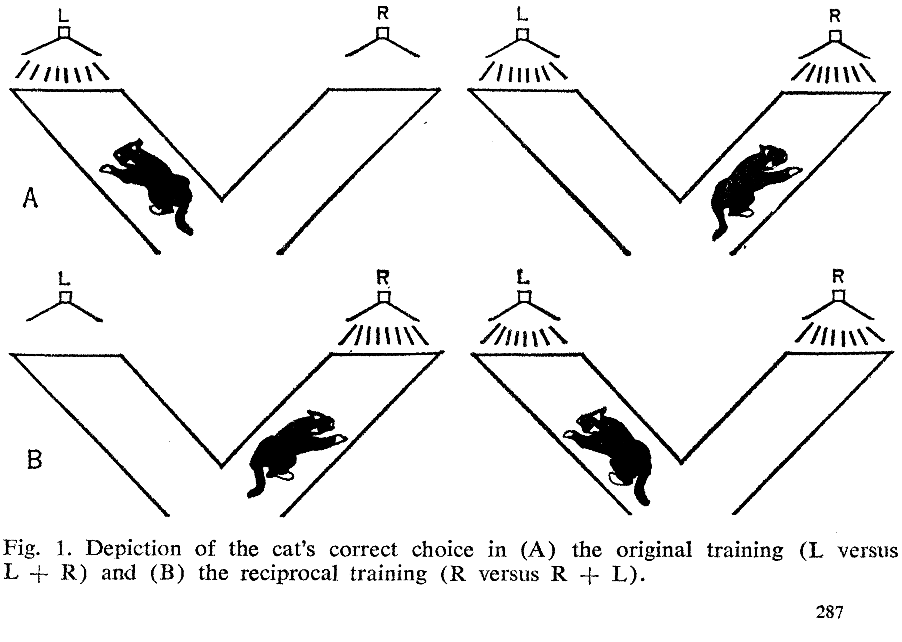

Fig. 1. Depiction of the cat's correct choice in (A) the original training (L versus L + R) and (B) the reciprocal training (R versus R + L).

rectly to either side when a single speaker sounded. We next postulate that if the leading pulse is contralateral to the intact hemisphere, then the tone pulse pair is perceived in the normal way, irrespective of training. However, if the leading pulse is contralateral to the damaged hemisphere, then the pulse pair is not perceived normally and the response tends to be to the side favored by training. This would not only explain the anomalous performance of cats with lesions on the right side to the LR pulse pair, but would also account for the apparently correct perception of the RL pulse pair by cats with lesions on the left side since both groups were trained to favor the right side.

To test these ideas we examined whether the effect of reciprocal training would cancel the effects of the original training. In the second experiment the same eight cats were trained in the reciprocal way shown schematically in Fig. 1B (R versus R + L). The results of learning the reciprocal task are shown in the second line of Table 1. Now it is the group of cats with lesions on the left side, previously severely impaired, which mastered the task in a few sessions, and the four cats with lesions on the right side failed to reach criterion in the allotted time (60 sessions). Thus, once again we encounter a symmetrical relation between the side on which the lesion occurred and the difficulty of the task. The extent to which the reciprocal training has reversed the favored side may be judged by the results of tests with "virtual left" and "virtual right" shown in the right half of Table 2. These results support the conclusion just drawn, that the pair of closely spaced tone pulses will be normally perceived if the leading member of the pair is opposite the intact hemisphere. The LR pair is judged to be on the left by cats with lesions on the left side and the RL pair is judged to be on the right by cats with lesions of the right auditory cortex. At the same time, the data support the conclusion that the locus of a pair of closely spaced tone pulses is not normally perceived when the leading sound is contralateral to the side of the lesion: The same cats, those with lesions of the left cortex, which before had apparently judged the RL pulse pair correctly now reveal a deficit in their perception of that pair; and the strong tendency of the group of cats with lesions on the right side to favor the right side (only 16 percent favor the left side) now has been overcome by the reciprocal training and these animals perform at a chance level of 53 percent.

Table 2. Virtual left and virtual right tests as a function of training and the side on which the lesion occurred. The proportions shown are the averaged proportions of responses to the side indicated by L or R.

Test	L versus L + R		R versus R + L	
	Left lesion	Right lesion	Left lesion	Right lesion
LR	0.89 L	0.16 L	0.92 L	0.53 L
RL	0.96 R	0.98 R	0.50 R*	0.78 R

* There were considerable individual differences, an indication of the variable effectiveness of the reciprocal training in reversing the earlier training.

Even though we do not wish to propose a single neural mechanism to account for our findings, there is a way of describing training effects and the role of lesion side in similar terms. Suppose that the training enhances the potency of stimuli on the side which must win out in competition with the opposite side. Suppose further that the lesion reduces the potency of the stimuli on the side contralateral to the lesion. Now these effects can work either in the same direction or in opposite directions. As an example of additive effects, we can cite the result of training cats with lesions on the left side to go left in the R + L test, and, as an example of antagonistic effects, we can cite the result of the same training procedure after a lesion is produced on the right side (see bottom line of Table 1). A similar interaction, that is, cooperation or competition, may be observed in the virtual right and virtual left tests. However, the training plays little or no role when the pair of stimuli is normally perceived, a condition which obtains when the leading sound is contralateral to the preserved auditory cortex. This result suggests that a unilateral lesion of the auditory cortex would disrupt the perception of the locus of pairs of pulses when the side of the leading pulse is ipsilateral to the preserved cortex, even in the untrained cat.

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Alcohol Dependence Produced in Mice by Inhalation of Ethanol: Grading the Withdrawal Reaction

Abstract. *Intoxicating blood levels of ethanol are maintained for several days in mice housed in an atmosphere of ethanol vapor. On removal from the alcohol, all the mice develop withdrawal signs. The signs can be graded to indicate the time course and intensity of the withdrawal reaction.*

Physical dependence is an aspect of drug addiction that lends itself well to analysis in quantitative terms, if an animal model is available. We describe here techniques for establishing and maintaining constant blood alcohol levels in small animals and for estimating the intensity of the subsequent withdrawal reaction (*1*). Such a model could be used to test the homeostat hypothesis (*2*)—the theory that adaptation to the continuous presence of a drug is the cause of both tolerance and physical dependence. A system under physiological control, such as an enzyme repressible by its product, could expand to offset the initial drug effect. On withdrawal, the inhibition would be removed and the overactivity of the expanded target system would be displayed.

The theory makes two predictions that are testable even without knowing what the target system is. (i) Physical dependence should develop over a period of hours or days (not years), in accordance with the time courses of known physiological regu-